

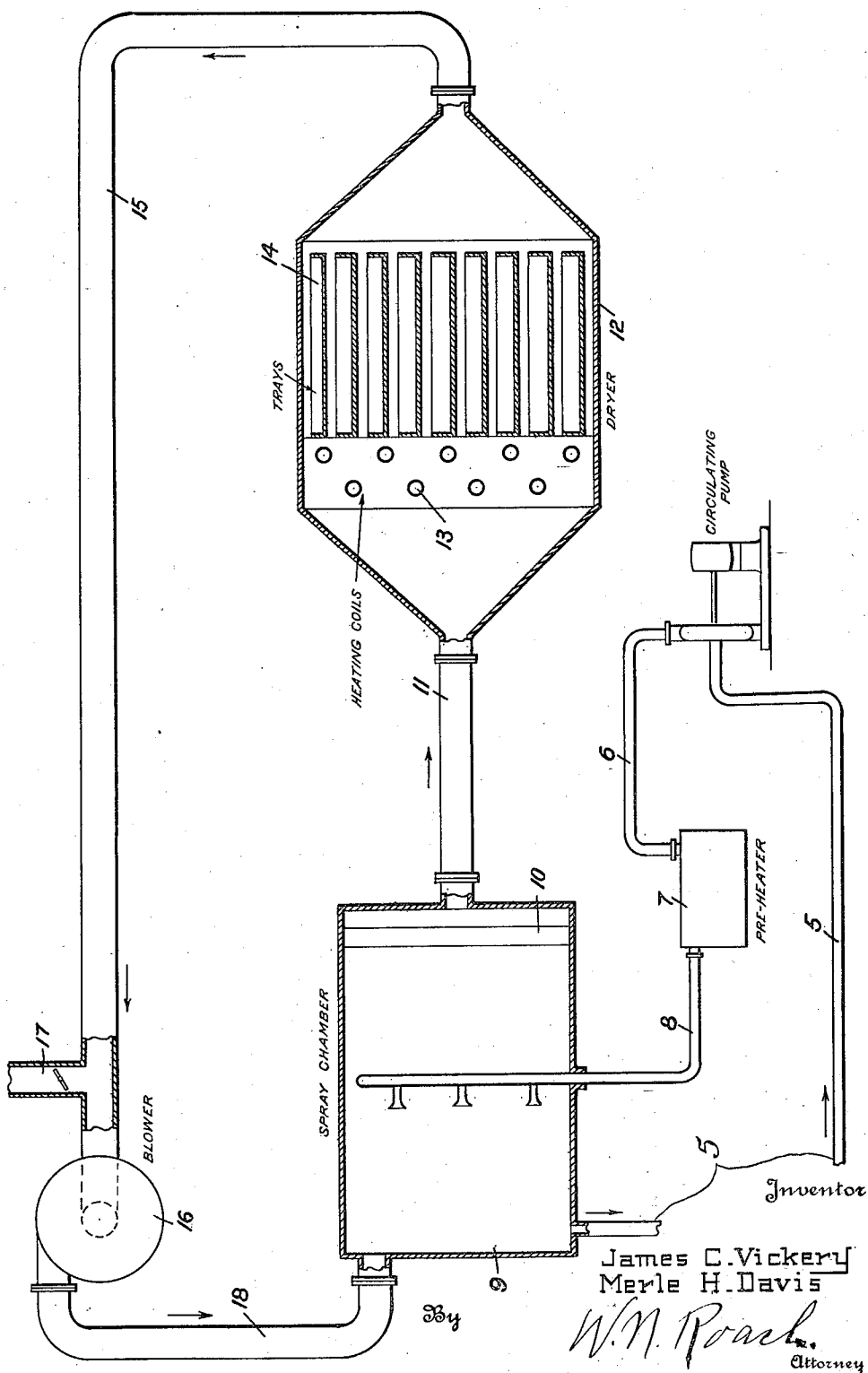
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J. C. VICKERY ET AL

PROCESS FOR DRYING SMOKELESS POWDERS

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## UNITED STATES PATENT OFFICE.

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## PROCESS FOR DRYING SMOKELESS POWDERS.

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*To all whom it may concern:*

Be it known that we, JAMES C. VICKERY, and MERLE H. DAVIS, citizens of the United States, and residents of, respectively, Evansville, in the county of Vanderburg and State of Indiana, and Fort Bragg, in the county of Cumberland and State of North Carolina, have invented an Improvement in Processes for Drying Smokeless Powders, of which the following is a specification.

The subject of the present invention is a method for removing surplus moisture from materials and the invention relates specifically to a process for drying smokeless powders.

The primary object of the present invention is the establishment of a method for the production of smokeless powder of superior quality by a process more economical than heretofore used.

A further object of the invention is the establishment of a process for drying smokeless powder in which the powder can be uniformly treated so as to remove from the powder the retained solvent without injury to the ballistic qualities of the powder.

A further object is the provision of means whereby the drying process, which forms the subject of this invention, may be carried on with the most economical employment of material.

With the foregoing and other objects in view, our invention resides in the novel steps comprising our process and in the details of procedure hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention.

The finishing of smokeless powder which comprises its treatment from a green state to the product ready for use, consists in removing from the green powder the excess ether, alcohol, or other volatile matter which has been previously added to the powder in the process of manufacture. In the past, this removal has been accomplished by any of several different methods which have proved more or less unsatisfactory, either because of the time required to complete the removal of the volatile solvent, or be-

cause the powder treated will undergo frequently a change from the desired ballistic qualities.

The finishing process may be regarded as comprising two distinct steps: first, the transference of the volatile matter or solvent from the interior to the surface of the grain; and, second, the transference of the volatile matter or solvent from the surface of the grain to the drying medium. The first of these processes is one of diffusion and subject to the ordinary laws of diffusion. The second of these processes is one of evaporation and is subject to the ordinary laws of evaporation. It is obvious that the slower of the two processes is the one which will determine the drying rate of the powder. It is the object of this invention to increase the slower of the two rates to the maximum value which the nature of the substance treated will permit. Since the first process is the slower and since an increase of temperature rapidly increases the rate of diffusion, we prefer to carry on our improved process of drying at an elevated temperature.

While it is possible with an elevated temperature to considerably hasten the transference of excess volatile matter or solvent from the interior to the surface of the grain, additional precaution must be taken in order to protect the material so as to prevent alteration of the ballistic qualities of the substance treated. In particular, it is necessary that the rate at which the solvent is transferred from the surface to the drying medium be regulated so that it will be equal to that at which the solvent is brought to the surface from the interior of the grain. In this way, it is possible to dry at an increased rate and to obtain a finished product which will have been subjected to uniform treatment throughout the entire section of the grain and which will therefore possess uniform properties throughout that section.

In carrying out the process which forms the subject of this invention, the granulated powder in its green state, will be subjected to the action of a drying medium which may consist of a gaseous carrier nearly, but not quite, saturated with the volatile matter

or solvent which is to be removed from the powder. While it has been found preferable in practice, to employ air as the gaseous drying medium, it is obvious that any other

5 suitable gas may be used without departing from the spirit of our invention. The process may be carried on by continually passing the drying medium over the powder to be dried so that as fast as the drying medium is saturated with the volatile matter or solvent removed from the powder being dried, it will be carried off and replaced by additional unsaturated drying medium capable of taking up additional volatile matter. 10 When the powder is dried by this method, a uniform drying will be accomplished since the volatile matter or solvent present in the drying medium will prevent too rapid evaporation at the surface of the powder grains while the drying medium itself will cause a diffusion of the solvent from the interior to the surface of the grain. In this way, powder can be dried retaining all the desired ballistic qualities.

15 While we prefer to carry out our process at an elevated temperature in order to produce rapid drying, it is obvious that the process may be conducted at ordinary temperatures if the drying medium is kept below its saturation point with the solvent to be removed from the powder.

Any suitable apparatus may be employed to carry out the process described. For the purpose of illustration reference may be had to the attached drawing, in which is shown diagrammatically one arrangement of apparatus for carrying out the process which forms the subject of this invention.

20 Using drying apparatus such as illustrated, the volatile matter will be conducted through the pipes 5 and 6 to a heater 7 where the temperature of the volatile matter is raised so that a sufficient amount of the volatile matter or solvent to be removed from the powder may be carried by the drying medium without saturation. From the heater, the volatile matter is conducted through a pipe 8 into a spray chamber 9 where it is mixed with a proper amount of the drying medium. Baffle plates, eliminators, or traps 10 may be placed in the spray chamber to prevent discharge of the drying medium from the spray chamber with any of the volatile matter or solvent entrained therein. 25 From the spray chamber the drying medium now partially saturated with the volatile matter or solvent to be removed, is conducted through a pipe 11 into the drier 12. It has been found desirable where rapid drying is a primary consideration to heat to an elevated temperature the drying medium before bringing it into contact with the powder. Any suitable heating means may be employed and the same may be located at 30 any convenient point in the system. As

shown, heating coils 13 are placed in the drier, so positioned that the drying medium passes first through these coils before being brought into contact with the powder which has been placed in the drier on trays 14. 70

A circulating fan or blower 16 may be installed at any convenient point in the system so as to insure proper circulation of the drying medium through the drier. The rapidity of circulation will depend upon the rapidity with which the drying medium absorbs moisture from the powder. The circulation should be such that as soon as the drying medium is saturated with the volatile matter or solvent to be removed, it passes 80 on out of the drier so that fresh unsaturated drying medium may continue the drying action.

From the drier, the now saturated drying medium may be conducted through a pipe 15 by means of a blower 16 and a pipe 18 back to the spray chamber 9 and thence into the primary conducting pipe 11. 85

The temperature in the spray chamber 9 is maintained at such a degree of heat that the drying medium passing therethrough is brought to a temperature sufficiently low to prevent complete saturation of the drying medium at the temperature at which it passes over the drying trays. 90 95

With apparatus such as described, continuous treatment of the powder is possible and the same drying medium may be employed over and over again so that the system described is most economical and efficient in its action. 100

While it is preferred to raise the drying medium to an elevated temperature for treatment of the powder, this is not necessary since the heating coils 13 may be incorporated in the system solely for the purpose of supplying a small amount of heat and a correspondingly small degree of unsaturation in the drying medium in order that the drying medium be capable of carrying away additional solvent. 105 110

The spray chamber 9 performs two functions: It removes a small amount of solvent from the drying medium coming from the drier and produces saturated gas at a slightly lower temperature. 115

While a particular system of drying apparatus has been described, it is not intended to limit this invention to the system illustrated, since it is possible to employ other pieces of apparatus or combinations of apparatus to accomplish the purpose desired. 120

It should be noted that the word "drying" as employed in this specification has a somewhat different meaning from that ordinarily employed in smokeless powder manufacture, inasmuch as it includes the processes which have been heretofore spoken of as solvent recovery and drying. As used in this application the drying process covers the whole pro- 125 130

cedure which takes the green powder as delivered by the cutter and delivers it ready to be packed.

While the process has been described in relation to the drying of smokeless powder, it is obvious that the method which forms the subject of this invention may be employed wherever it is possible to use as a drying medium a gaseous carrier partially saturated with a volatile material which it is desired to remove from a substance containing that volatile material.

Having thus described our invention, what we claim is:

1. The method of removing solvent from smokeless powder which includes partially saturating a gaseous carrier with the solvent to be removed in a vaporized state, passing the partially saturated carrier at an elevated temperature over the powder, restoring

the carrier to partial saturation and repeating the operation until the solvent in the powder has been decreased the required amount.

2. The method of removing solvent from smokeless powder which includes drying the powder at an elevated temperature with air partially saturated with the solvent.

3. The method of removing solvent from smokeless powder which includes heating a desired amount of solvent, spraying the hot solvent into a gaseous carrier to partially saturate the same, raising the temperature of the gaseous carrier and passing it over the powder and then restoring the carrier to a state of partial saturation and repeating the operation until the solvent in the powder has been reduced to the desired degree.

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